PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference	FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
P67118PC00		
International application No.	International filing date *(day/month/year)*	Priority date *(day/month/year)*
PCT/NL 03/00833	26.11.2003	
International Patent Classification (IPC) or both national classification and IPC		
H03F1/32		
Applicant		
TELEFONAKTIEBOLAGET L.M. ERICSSON et al.		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 4 sheets, including this cover sheet.

   ☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

   - I ☒ Basis of the opinion
   - II ☐ Priority
   - III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
   - IV ☐ Lack of unity of invention
   - V ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
   - VI ☐ Certain documents cited
   - VII ☐ Certain defects in the international application
   - VIII ☐ Certain observations on the international application

Date of submission of the demand	Date of completion of this report
16.06.2005	22.03.2006
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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/NL 03/00833

I. Basis of the report

1. With regard to the **elements** of the international application *(Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17))*:

Description, Pages

1-15 as published

Claims, Numbers

1-15 received on 07.03.2006 with letter of 06.03.2006

Drawings, Sheets

1/6-6/6 as published

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

   (Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes:	Claims	1-15
	No:	Claims	
Inventive step (IS)	Yes:	Claims	1-15
	No:	Claims	
Industrial applicability (IA)	Yes:	Claims	1-15
	No:	Claims	

2. Citations and explanations

   see separate sheet

1. **The following documents will be referred to in this international preliminary examination report:**

   D1 = WO 01/08294 D2 = US 2003/179831

2. **The examiner is of the preliminary opinion that the present application does not meet the requirements of Art. 6 PCT,** because the subject-matter of claim 1 is not clear.

2.1 Due to the purely optional feature that "a cross-correlation signal can be present-ed" at a cross-correlator output, the "cross-correlator device" is only defined by the presence of "a first cross-correlator input", "a second cross-correlator input" and "a cross-correlator output". Since "a cross-correlation signal can be presented" at the cross-correlator output, the wording of claim 1 encompasses also the possibility that a completely different kind of signal is present at this output or that a different device 'presents' such a cross-correlation signal to the output of the cross-cor-relator. Due to these interpretation possibilities, the scope of claim 1 is much broader than justified by the remaining application documents which disclose exclusively embodiments comprising a cross-correlator (110) providing a cross-correlation signal. In order to allow a meaningful examination, it was assumed during the following examination that the cross-correlator outputs a cross-correlation signal.

3. **With reference to item V,** the examiner is of the preliminary opinion that the application meets the requirements of Art. 33 (2) and (3) PCT.

3.1 None of the above cited documents discloses a pre-distortion control device that measures a cross-correlation and that compares this measured cross-correlation with a cross-correlation model to select a suitable pre-distortion function. Thus, the subject-matter of the claims 1-15 is new and involves an inventive step, as re-quired by Art. 33 (2) and (3) PCT.

CLAIMS

1. A predistortion control device (1), including:

a first predistortion control input (10) connectable to a power amplifier output (21);

a second predistortion control input (11) connectable to a signal contact (30,31) of a predistortion device (3); and

a predistortion control output (12) connectable to a control contact of the predistortion device,

the predistortion control device (1) further including:

a cross-correlator device (110) connected with

a first cross-correlator input (1101,1101I,1101Q) to the first predistortion control input (10) and

a second cross-correlator input (1102,1102I,1102Q) to the second predistortion control input (11), which cross-correlator device (110) further has

a cross-correlator output (1112) (1112) at which a cross-correlation signal can be presented, the cross-correlation signal representing a measured cross-correlation (R_m) of signals presented at the first cross-correlator input (1101,1101I,1101Q) and the second cross-correlator input (1102,1102I,1102Q);

a predistortion function selector device (120), connected with

a selector input (1210) to the cross-correlator output (1112), and with

a selector output (1211) to the predistortion control output (12), said predistortion function selector device being arranged to compare the measured cross-correlation with a cross-correlation model stored in a memory (122) and determining on the basis of said comparison a suitable predistortion function and presenting a predistortion control signal at said selector output said predistortion control signal representing said predistortion function.

2. A predistortion control device (1) as claimed in claim 1, further including a quantiser device (101) connected with a quantiser input to the first predistortion control input, and with a quantiser output to the first cross-correlator input (1101,1101I,1101Q).

3. A predistortion control device (1) as claimed in claim 2, wherein the quantiser device (101) is a single-bit quantiser.

4. A predistortion control device (1) as claimed in claim 2 or 3, wherein the quantiser (101) is operable as a subsampling device.

5. A predistortion control device (1) as claimed in any one of claims 2-4, wherein the cross-correlator device (110) includes a single-bit multiplier (111).

6. A predistortion control device (1) as claimed in any one of the claims 2-5, further including
a distortion device (102) connected with a distortion input to the first predistortion control input, and connected with a distortion output to the quantiser input.

7. A predistortion control device (1) as claimed in claim 6, wherein the distortion device includes a random distortion device.

8. A predistortion control device (1) as claimed in claim 6 or 7, wherein the distortion device includes a periodic distortion device.

9. A predistortion control device (1) as claimed in any one of the preceding claims, wherein the second predistortion control input (11) is connectable to a signal output of a predistortion device.

10. A predistortion control device (1) as claimed in any one of the preceding claims, further including:
an averaging device (112) capable of determining a time averaged cross-correlation value from a memory connected to the cross-correlator output (1112), for storing a number of cross-correlation values, which averaging device has an averaging output connected to the selector input, for presenting time averaged cross-correlation values to the predistortion function selector device (120).

11. An assembly of a predistortion control device (1) as claimed in any one of claims 1-10, and a predistortion device (3) having signal contacts (30,31) including a predistortion input (30) for receiving an original signal to be predistorted and a predistortion output (31) for providing a predistorted output signal based on the original signal, and a control input contact (32) connected to the predistortion control output (12) at which a predistortion control signal can be provided, in response to which predistortion control signal the predistortion device uses a predistortion function corresponding to the predistortion control signal to generate the predistorted output signal

12. An assembly as claimed in claim 11, further including a power amplifier (2) connected with an amplifier input (20) to the predistortion output (31), and with an amplifier output (21) to the first predistortion control input (100.

13. An electronic device (200), such as a wireless communication device, including a predistortion control device (1) or an assembly as claimed in any one of claims 1-12.

14. A predistortion control method, including:
receiving a power amplifier output signal;
receiving a predistortion signal from a signal contact of a predistortion device;
determining a measured cross-correlation by cross-correlating the power amplifier output signal and the predistortion signal;
comparing the measured cross-correlation value with an cross-correlation model;
determining from said comparing a suitable predistortion function, and
providing a predistortion control signal representing said predistortion function.

15. A predistortion control method, as claimed in claim 14, comprising:
minimising a difference between the measured cross-correlation value with an model cross-correlation value, and
deriving from said minimising the predistortion function.